



**Testimony before the U.S.-China Economic and Security Review Commission
“U.S. Investment in China’s Capital Markets and Military-Industrial Complex”**

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Chairman Borochoff, Chairman Fiedler, members of the Commission: Thank you for the opportunity to testify today.

Together with my colleagues at the Center for Security and Emerging Technology (CSET), a nonpartisan, data-driven policy think tank within Georgetown University, I research trends related to global investment in emerging technologies, particularly artificial intelligence (AI) and advanced semiconductors. My testimony will focus on these areas in addressing the themes suggested by the Commission. I will cover the following points:

- **The technological competition between the United States and China is dynamic and hard to score; any U.S. advantages cannot be taken for granted.** The U.S. and its allies have advantages in many technologies, but these advantages may not be durable or geopolitically meaningful.
- **Many types of businesses, with varying relationships to the government, are fueling China’s technological development.** China’s cutting-edge tech companies range from small startups to massive corporations. These firms draw support from the government in many ways; some are more tightly state-linked than others. Traditional state-owned enterprises play a limited role.
- **China’s technology innovators need capital, and China’s government intervenes heavily in capital allocation.** Individual Chinese companies benefit from the largesse of the central, provincial, and local authorities, with resultant harm to their competitors in the U.S. and elsewhere.
- **Government guidance funds exemplify the potential strengths, weaknesses, and uncertainties of China’s approach.** These public-private investment vehicles are channeling massive amounts of capital into strategic technologies. Despite their potential strengths, they have often faltered in practice, and their contribution to China’s long-term technological development remains uncertain.

¹ Thanks to Ashwin Acharya, Martin Chorzempa, Danny Hague, Saif Khan, Lorand Laskai, Ngor Luong, Anna Puglisi, Helen Toner, and Lynne Weil for helpful input. All errors are mine.

- **Foreign investors are active in China’s technology sector, but they are not central players.** Capital, particularly American capital, is not currently a limiting factor in China’s technology industry. Chinese tech firms depend more on other types of foreign inputs, such as expertise.
- **U.S. restrictions on investment on mainland China exchanges are unlikely to meaningfully affect the state of play.** China’s technology strategy doesn’t depend on these capital flows. Broader investment restrictions might have more impact, but would risk significant collateral damage to American investors.
- **Any U.S. restrictions on investment in China should be multilateral, better informed, and part of a broader strategy to maintain the technological advantage of the United States and its democratic allies.** Investment restrictions may have a role to play, if well targeted and coordinated with allies. However, shoring up U.S. advantages in human capital and other domains would probably have a greater impact.

The technological competition between the United States and China is dynamic and hard to score; any U.S. advantages cannot be taken for granted

Any appraisal of China’s technological competitiveness should begin by acknowledging that we have incomplete, uncertain information about Chinese science and technology. In recent years, China has moved surprisingly fast in domains from genomic editing to military aviation.² The Chinese government has also invested heavily in monitoring, acquiring, and adapting scientific and technological advances in the United States and other countries. The United States has made no similar effort, and as a result, we lack insight into many aspects of China’s technological enterprise.³ Our understanding of China’s defense-related technological development is especially limited. The Chinese government is notoriously opaque about military matters, and any relevant information published in the open tends to be in Chinese-language outlets that often go untranslated.

This uncertainty notwithstanding, experts believe that the United States and its allies currently enjoy an advantage in many technologies relevant to defense and national security.⁴

² Jon Cohen and Nirja Desai, “With its CRISPR revolution, China becomes a world leader in genome editing,” *Science*, August 2, 2019, <https://www.sciencemag.org/news/2019/08/its-crispr-revolution-china-becomes-world-leader-genome-editing>; Liu Zhen, “China military’s landmark J-20 stealth fighter started a decade of modernisation,” *South China Morning Post*, January 31, 2021, <https://www.scmp.com/news/china/military/article/3119615/china-militarys-landmark-j-20-stealth-fighter-started-decade>.

³ William Hannas and Huey-Meei Chang, *China’s STI Operations: Monitoring Foreign Science and Technology Through Open Sources* (Center for Security and Emerging Technology, January 2021), <https://cset.georgetown.edu/research/chinas-sti-operations/>.

⁴ See, e.g., the USCC testimony of Jeffrey Ding (June 7, 2019) (discussing artificial intelligence); Andrea Gilli and Mauro Gilli, “Why China Has Not Caught Up Yet: Military-Technological Superiority and the Limits of Imitation, Reverse Engineering, and Cyber Espionage,” *International Security*, vol. 43, no. 3, p. 141, https://www.mitpressjournals.org/doi/full/10.1162/isec_a_00337.

This advantage is greatest, and probably most durable, in areas where implicit “know-how” and accumulated human capital are most important, and in areas where incumbency confers a large advantage (for example, through the existence of natural monopolies), making it hard for Chinese entrants to catch up.⁵ Examples include high-end semiconductors, semiconductor manufacturing equipment, and turbofan engines.⁶ The U.S. advantage over China in “breakthrough” fundamental research is also widely acknowledged in both nations, though its strategic relevance is debated.⁷ Areas of probable Chinese advantage, or at least rough parity, include facial recognition and materials science.⁸

However, this type of scorekeeping leaves out key dimensions of the technological competition between China and the United States. In fact, even if China’s technology trailed America’s across the board, America still might not have a significant military or geopolitical advantage.

First, emerging technologies evolve quickly and unpredictably. National leads in any particular technology may evaporate, or be made irrelevant. For instance, Chinese companies’ cutting-edge facial recognition systems use deep learning techniques that emerged into widespread use only a few years ago.⁹ In this dynamic environment, China will have opportunities to “leapfrog” to the cutting edge in many sectors, and it intends to seize them.¹⁰ Continued U.S. leadership will depend on our ability to cultivate a robust innovation ecosystem that stays one step ahead.

Second, the key technologies of our era involve complex combinations of many different inputs. Rarely, if ever, does a single nation or firm control all of these inputs. This means even America’s greatest technological advantages are rooted in interactions with many other countries, China prominent among them. Today, American pharmaceutical companies use Chinese-manufactured ingredients, Silicon Valley’s tech giants open labs in China and around the world to access the talented researchers they need, and U.S. semiconductor firms depend on revenue from Chinese markets to fund costly research into cutting-edge computer chips. These exchanges provide the United States important benefits, but they also create

⁵ See generally Andrea Gilli and Mauro Gilli, “Why China Has Not Caught Up Yet: Military-Technological Superiority and the Limits of Imitation, Reverse Engineering, and Cyber Espionage,” *International Security*, vol. 43, no. 3, p. 141, https://www.mitpressjournals.org/doi/full/10.1162/isec_a_00337.

⁶ See id. at 182-84; Saif M. Khan, *The Semiconductor Supply Chain: Assessing National Competitiveness* (Center for Security and Emerging Technology, January 2021), <https://cset.georgetown.edu/research/the-semiconductor-supply-chain/>.

⁷ See William Hannas and Huey-Meei Chang, *China’s Access to Foreign AI Technology: An Assessment* (Center for Security and Emerging Technology, September 2019), 7-8, <https://cset.georgetown.edu/research/chinas-access-to-foreign-ai-technology/>.

⁸ See, e.g., Lauren Dudley, “China’s Ubiquitous Facial Recognition Tech Sparks Privacy Backlash,” *The Diplomat*, March 7, 2020, <https://thediplomat.com/2020/03/chinas-ubiquitous-facial-recognition-tech-sparks-privacy-backlash/>; Sarah O’Meara, “Materials science is helping to transform China into a high-tech economy,” *Nature*, March 20, 2019, <https://www.nature.com/articles/d41586-019-00885-5>.

⁹ See generally Dave Gershgorin, “The data that transformed AI research—and possibly the world,” *Quartz*, July 26, 2017, <https://qz.com/1034972/the-data-that-changed-the-direction-of-ai-research-and-possibly-the-world/>.

¹⁰ Lauren Dudley, “China’s Quest for Self-Reliance in the Fourteenth Five-Year Plan,” *CFR Net Politics*, March 8, 2021, <https://www.cfr.org/blog/chinas-quest-self-reliance-fourteenth-five-year-plan>.

vulnerabilities and potential chokepoints. America may have a technological advantage in the sense that its medicines, software, and computer chips are currently better than their Chinese competitors, but in an interdependent world, the geopolitical impact of this advantage may be limited. Chinese policymakers understand this, and have encouraged and manipulated interdependence in key domains in order to build their leverage.

Third, many, if not most, of today's emerging and strategic technologies must be adapted from commercial to defense use, adding another tricky dimension to the question of technological advantage. Former Secretary of Defense Ashton Carter put it bluntly: "all technology of consequence for protecting our people, and all technology of any consequence at all, [once] came from the United States and came from within the walls of government. Those days are irrevocably lost. . . . [now] I've got to go outside the Pentagon no matter what."¹¹ America may boast the world's most innovative technologies, but if the government and military can't effectively acquire, adapt and deploy them, the national defense won't benefit. For its part, though some aspects of its "military-civil fusion" efforts are easily exaggerated, China has shown signs of being able to rapidly field new defense platforms and commandeer its nominally private sector for state purposes.¹² If it can generalize and extend these capabilities, and nurture other connections between the defense sector and market-oriented innovators, China could benefit enormously.

In short, America may currently lead China in many technologies, but these leads are not necessarily durable or consequential. America's geopolitical advantage will turn not only on the sophistication of our technologies, but also on the continuing vibrance of our broader innovation system, the nature and extent of our technological interdependence with China and other nations, and our ability to move commercial technologies into the public sector.

Many types of businesses, with varying relationships to the government, are fueling China's technological development

China's technology sector is diverse. Traditional state-owned enterprises (SOEs), the leaders in earlier phases of China's industrialization, play a less significant role than they once did. They still have a large footprint in China's broader economy, and remain dominant in some sectors, including sectors directly related to China's military, such as aircraft and nuclear science. But in many other emerging technologies, the commercial sector has taken the lead. Academic researchers, market experts, and technologists agree that SOEs tend to be less active at the cutting edge - though there are exceptions, and state-owned firms continue to

¹¹ Eric Johnson, "Former Defense Secretary Ash Carter Says AI Should Never Have the "True Autonomy" to Kill," *Vox*, May 13, 2019, <https://www.vox.com/recode/2019/5/13/18617081/secretary-defense-ash-carter-ai-lethal-kill-ethics-harvard-facebook-kara-swisher-decode-podcast>.

¹² See, e.g., William Greenwalt and Dan Patt, *Competing in Time: Ensuring Capability Advantage and Mission Success through Adaptable Resource Allocation* (Hudson Institute, February 25, 2021), 36, <https://www.hudson.org/research/16717-competing-in-time-ensuring-capability-advantage-and-mission-success-through-adaptable-resource-allocation>; Zach Dorfman, "Tech Giants Are Giving China a Vital Edge in Espionage," *Foreign Policy*, December 23, 2020, <https://foreignpolicy.com/2020/12/23/china-tech-giants-process-stolen-data-spy-agencies/>. On military-civil fusion, see Elsa B. Kania and Lorand Laskai, *Myths and Realities of China's Military-Civil Fusion Strategy* (Center for a New American Security, January 28, 2021), <https://www.cnas.org/publications/reports/myths-and-realities-of-chinas-military-civil-fusion-strategy>.

provide the underlying infrastructure, such as energy and telecommunications, on which emerging technologies depend.¹³

Instead, a panoply of market-oriented firms is pushing Chinese technology ahead. China's AI sector illustrates the range of players involved:

- **Large, diversified public tech companies**, such as the “BAT” firms (Baidu, Alibaba, Tencent), which have massive AI operations alongside activity in other sectors, from gaming to warehousing.
- **Large, tech- and AI-focused public companies** specializing in different aspects of the AI ecosystem. *Examples: iFlyTek (AI applications), Cambricon (AI hardware).*
- **Large public companies in other industries**, many of which are launching AI subsidiaries and lines of business in order to diversify or to support other activities. *Examples: Ping An Insurance, Hikvision, Guangzhou Automobile Industry Group.* Some state-owned enterprises fit this description. *Examples: State Grid, China Telecom.*
- **Large privately held companies**, in many cases much larger than their publicly traded counterparts. *Examples: Huawei, SenseTime, Megvii.*
- **Startups and small- and mid-size privately held companies** active across a range of AI input and application areas.

It is important not to confuse the limited role of SOEs with the absence of the state itself. In China's “state capitalist” economy, innovative enterprises from small startups to the largest tech giants are entangled with the government in myriad ways. They may be founded within public universities and research centers; receive equity investment from state-backed investors; participate in industry alliances and standards organizations formed by the government; borrow money on favorable terms from state banks; work with government agencies to acquire technology and attract business partners from abroad; benefit from regulations restricting their foreign competitors; incorporate the Communist Party into their corporate governance; modify products to suit the government's preferences; serve the state as a customer, or even be commandeered for public purposes; and so on. In short, though it formally owns and controls less of the market in emerging technologies such as AI, the Chinese state is still pervasive in these sectors.

That is not to say, however, that innovative companies all march in lockstep with the government, or that Party bureaucrats are micromanaging any particular company's

¹³ See, e.g., “Who can become the ‘new SOEs’ of this new digital infrastructure?” [数字新基建, 谁能成为「新国企」?], *Taihe Industry Observer* [钛禾产业观察], April 15, 2020, <https://mp.weixin.qq.com/s/vDuDYcmAGrQQqzZykOnlxQ?fbclid=IwAR08sUD0IFr3rPJ6WZoepZC4dVRpdbAeaDKuk-Md-iheRK0kJRDFbe8W9Pk> (translated in Jeffrey Ding, “ChinAI #91: Introducing Taihe (China's mini Defense One?) - Let's Read it Together,” *ChinAI Newsletter*, April 27, 2020, <https://chinai.substack.com/p/chinai-91-introducing-taihe-chinas>); Kevin Zheng Zhou, “State Ownership and Firm Innovation in China: An Integrated View of Institutional and Efficiency Logics,” *Administrative Science Quarterly*, vol. 62, no.2, p. 375 (October 10, 2016), <https://journals.sagepub.com/doi/abs/10.1177/0001839216674457>.

activities on a regular basis. The boundary between the Chinese state and private business is often illusory, but still, Chinese entrepreneurs and businesspeople have their own agendas. Like their counterparts anywhere else, they are focused on profit, don't always welcome government involvement, and sometimes may be able to fend it off.¹⁴ More fundamentally, the Chinese technology sector is too vast, complex, and dynamic for the government to fully control - even a government with the reach of the Chinese Communist Party. Rather, a give and take exists, and the extent of alignment with the Chinese state varies meaningfully in different settings and from company to company, in each case according to that company's specific activities and circumstances.

China's technology innovators need capital, and China's government intervenes heavily in capital allocation

Emerging technologies need capital to develop, and finance is a central aspect of China's technological ecosystem. It is especially important in a few parts of this ecosystem. Early-stage businesses need access to risk-tolerant capital - typically venture capital - to establish themselves before they can "go to market" and begin earning revenue from customers. And among more mature companies, some need much more capital than others. For example, semiconductor factories cost tens of billions of dollars; a single high-end lithography machine, used to draw nano-scale circuits into computer chips, sells for about \$170 million.¹⁵ Electric vehicles are another capital-intensive sector; China's EV industry has received infusions of cash from the government as it develops.¹⁶ Even technologies thought of as less costly to develop, such as software, may demand lots of capital at the cutting edge. No factories are needed to build machine learning models, but the most advanced models can require millions of dollars' worth of energy and computing time to develop.¹⁷

In the past, China's government might have addressed these needs by distributing resources directly to companies, or operating the companies as extensions of the state. These practices continue today to some extent. However, China's leaders have begun to move beyond the traditional and inefficient mechanisms of the command economy. Increasingly, their aim is to use market mechanisms to mediate between the state's high-level technological priorities and the industries and firms that can actually enact them.¹⁸ China's state-owned financial

¹⁴ See, e.g., Sun Yu, "Jack Ma's Ant defies pressure from Beijing to share more customer data," *Financial Times*, March 1, 2021, <https://www.ft.com/content/1651bc67-4112-4ce5-bf7a-d4ad7039e7c7>.

¹⁵ CSET calculation based on data in ASML's Q4 2020 Financial Report, available at <https://www.asml.com/en/investors/financial-results/q4-2020>.

¹⁶ See Daniel Ren, "Xpeng's US\$1.98 billion credit line from state-owned banks suggests China is throwing weight behind leading electric vehicle firms," *South China Morning Post*, January 12, 2021, <https://www.scmp.com/business/companies/article/3117462/xpengs-us198-billion-credit-line-state-owned-banks-suggests>.

¹⁷ Or Sharir et al., *The Cost of Training NLP Models: A Concise Overview* (April 2020), <https://arxiv.org/pdf/2004.08900.pdf>; "The cost of training machines is becoming a problem," *The Economist*, June 13, 2020, <https://www.economist.com/technology-quarterly/2020/06/11/the-cost-of-training-machines-is-becoming-a-problem>.

¹⁸ See, e.g., pp. 18-19 of the Government Work Report from this year's "Two Sessions": "We will fully leverage the decisive role of the market in allocating resources and give better play to the role of government, to ensure better alignment between an efficient market and a well-functioning government. We will continue to expand market

institutions, its increasingly mature domestic capital markets, and the bevy of domestic and foreign investors eager for high-return technology investments provide enabling infrastructure for this strategy.

Chinese authorities at the central, provincial, and local levels use many tools to guide capital to strategic industries. Individually, some of them would not be out of place in other countries. Together, though, they are an unusually broad and pervasive toolkit for allocating capital. Among the more important tools:

- State banks provide below-market loans and trade financing to favored technology companies.
- Government leaders designate particular industries and firms as nationally strategic, which signals that these industries and firms are likely to enjoy government support (financial, regulatory or otherwise), encouraging others to invest in them.
- SOEs, state investment funds, and public-private “guidance funds,” discussed in detail below, make equity investments in a wide range of firms, from small startups to tech giants.
- Government-sponsored industry alliances, incubators, and technology parks help connect promising startups to state and nonstate investors.

It’s also worth noting that Chinese government agencies are major buyers in industries such as surveillance, enterprise software, and “smart city” technology. This isn’t an intervention in the capital markets per se, but it does provide a financial bulwark for these industries.

China’s tech companies rely on government-provided and government-“guided” capital to varying degrees. Companies seeking to break into especially capital-intensive sectors, such as the semiconductor and EV firms discussed above, may struggle to raise enough money from private investors, leaving the government to fill the gap - in some cases, to the tune of billions of dollars.¹⁹ Meanwhile, startups seeking to commercialize unproven technologies often face a financial “valley of death”: they need money to scale up production, but don’t yet have paying customers. The government is well suited to provide “patient capital” to sustain these companies. On the other hand, industries with lower capital needs and ready markets may have easier access to private capital (or less need for it in the first place) and tend to rely less on public support. Examples include consumer finance, social media, business services, and advertising.

China’s government’s overt role in that country’s capital markets has provoked extreme, often contradictory reactions abroad. Some observers take its ambitious strategy documents

access, pilot a comprehensive reform on the market-based allocation of production factors, and ensure equal protection for the property rights of various market entities in accordance with the law.” (available at <https://drive.google.com/file/d/1pKBavUfkZsvmQcnLDdd4yepq7nwbWqp/view>)

¹⁹ See generally *Measuring distortions in international markets: The semiconductor value chain* (Organisation for Economic Cooperation and Development, December 12, 2019), https://www.oecd-ilibrary.org/trade/measuring-distortions-in-international-markets_8fe4491d-en.

at something close to face value, warning that China’s purposeful “state capitalism” will out-innovate and outcompete the messy, decentralized American way. Others are incredulous, pointing to widespread corruption and bloat in the Chinese system and a string of high-profile failures, such as the recent, spectacular implosion of a semiconductor manufacturer backed by the Wuhan city government.²⁰

In reality, it’s too early to know whether China’s current approach, and the capital allocation strategies it involves, can build a sustainable, comprehensive innovation ecosystem. Clearly, the individual companies receiving financial support from, or at the behest of, the state enjoy an advantage over their unsubsidized competitors at home or abroad. And the Chinese government’s ability and willingness to direct capital can drive domestic progress in specific, selected sectors. Still, the distortions and inefficiencies this strategy introduces could undermine China’s broader technological development in the long term. A closer look at guidance funds, one of the Chinese government’s main tools for allocating capital, illustrates these dynamics.

Government guidance funds exemplify the potential strengths, weaknesses, and uncertainties of China’s approach²¹

Guidance funds are public-private investment vehicles that aim to both produce financial returns and further the state’s industrial policy goals. Sponsored by central, provincial, and local authorities, they generally focus on strategic and emerging sectors, such as artificial intelligence. As of the first quarter of 2020, Chinese officials had set up 1,741 guidance funds, with a cumulative registered target size of 11 trillion RMB (1.55 trillion USD) and about 4.76 trillion RMB (672 billion USD) in actual funds raised.²²

Each guidance fund’s governmental sponsor typically contributes 20 to 30 percent of the fund’s capital, then seeks to raise the rest from so-called “social capital” investors, which may include SOEs, corporations, and state and non-state financial institutions. To entice these social capital investors, government sponsors in guidance funds may forgo their own interest payments, assume other investors’ losses, or provide other incentives. The government’s sizable capital contributions also reduce other investors’ exposure and signal the government’s commitment to relevant industries.

Guidance funds have developed in three phases. In the first phase, lasting through the early-to mid-2010s, central and local governments set up a number of initial funds and established a supporting legal framework. The second phase saw a boom in guidance funds between

²⁰ See Kevin Xu, “China’s ‘Semiconductor Theranos’: HSMC,” *Interconnected*, March 4, 2021, <https://interconnected.blog/chinas-semiconductor-theranos-hsmc/>.

²¹ This section of my testimony is adapted from Ngor Luong, Zachary Arnold, and Ben Murphy, *Understanding Chinese Government Guidance Funds* (Center for Security and Emerging Technology, March 2021), <https://cset.georgetown.edu/research/understanding-chinese-government-guidance-funds/>, and Ngor Luong, Zachary Arnold, and Ben Murphy, *Chinese Government Guidance Funds: A Guide for the Perplexed* (Center for Security and Emerging Technology, March 2021), <https://cset.georgetown.edu/research/chinese-government-guidance-funds/>.

²² “Government Guidance Fund Trends” [政府引导基金动态], Zero2IPO [情科研究中心], 2020, https://m.pedata.cn/special_do/govFund/web (archived at <https://perma.cc/67SK-BH7R>).

2015 and 2018, fueled by central government policies, relatively loose regulation, new restrictions on other types of local government spending, and trend-chasing among provincial and local bureaucrats. In the third phase, beginning around 2018, formation and fundraising slowed down, due in large part to broader economic headwinds in China and tighter regulations.

Guidance funds are unquestionably helping to mobilize money and other resources for emerging and strategic industries, and they have several potential advantages over traditional Chinese industrial policy mechanisms:

- By bringing the profit motive into industrial policy, the guidance fund model could reduce the inefficiency and corruption associated with subsidy schemes and other traditional policy tools. Chinese policymakers hope that professional fund managers and profit-oriented social capital investors will discipline the guidance funds in which they participate, and bring in capital, information, contacts, and expert judgment beyond what the state can provide.
- With their government backing and strategic mandate, guidance funds are also well positioned to provide patient capital, a critical resource for emerging technologies.
- Finally, guidance funds can complement and amplify other industrial policy measures, producing robust, holistic support for emerging and high-tech businesses. To attract high-quality targets, many guidance fund institutions provide or coordinate other incentives, such as state-sponsored technology parks, R&D incentives, and talent recruitment plans. In the ideal case, this produces comprehensive ecosystems of support, fostering local economies of scale and helping emerging and strategic businesses take off.

However, these advantages are not always realized. Many guidance funds are poorly conceived and implemented, and the model as a whole is often inefficient:

- Guidance funds frequently raise much less money than planned, and much of the money they do raise is never actually invested. New funds routinely plan to raise hundreds of millions or even billions of yuan, but struggle to raise money from both public sponsors and social capital investors, who are wary the funds will produce competitive returns. Funds that do raise money often fail to find targets, leaving money idle in bank accounts.
- There are too many guidance funds. By the first half of 2019, local governments alone had set up 1,300 guidance funds with frequently overlapping policy objectives, leading to shortages of social capital investors, suitable investment targets, and fund management talent. The same year, one market research firm noted that “[a] western province has several special government guidance funds for investing in biotech and

pharmaceuticals, and one city in central China has nearly ten government guidance funds for strategic emerging industries.”²³

- Many guidance funds are badly managed. Guidance funds may engage in wasteful or even illicit activities, such as facilitating unauthorized borrowing by local governments. Sponsors often rely on inexperienced, excessively risk-averse bureaucrats or poorly incentivized investment managers to manage them.
- Especially at the subnational level, guidance funds frequently ignore market fundamentals, which can lead to bad investment decisions. “A biotech and pharmaceutical industry cannot be developed in every province,” one official complained in 2016, “but every province is blindly trying to create such an industry through [guidance] funds. . . . It’s ‘national strategic industry’ this, ‘emerging industry’ that. . . . Government guidance funds have entered an era of wild growth and we must get to the root of the problem.”²⁴
- There is some evidence that guidance funds crowd out private capital, undermining their goal of increasing the total pool of capital available for strategic industries and potentially making the market as a whole less efficient.

For the most part, these flaws are rooted in basic issues of institutional capacity and contradictions in the guidance fund model—between government aims and the profit motive, and between national visions for technological development and local economic and political interests. These fundamental issues are present, to some extent, in all forms of state-directed capital allocation in China, and it’s doubtful they will be overcome.

But although guidance funds may never meet their sky-high ambitions, they could still help China push ahead in technology, especially considering the Chinese government’s apparent willingness to tolerate some amount of waste and inefficiency in pursuit of its technological goals. Critically, even with its problems, the guidance fund mechanism probably improves on the deeply flawed traditional policy tools that might otherwise be used to support strategic industries, such as direct government ownership or cash handouts to state-favored companies. It remains to be seen whether it is improved enough to meaningfully advance China’s ambitious technological agenda.

Foreign investors are active in China’s technology sector, but they are not central players

In absolute terms, foreign investors have a large presence in China’s tech sector. According to official statistics, the Chinese IT sector alone attracted over \$11 billion in foreign direct

²³ “Report on the Development of Chinese Government Guidance Funds 2019 (Part 1)” [2019年中国政府引导基金发展研究报告(上篇)] at 23, Zero2IPO [精科研究中心], October 17, 2019, available for purchase at <https://research.pedaily.cn/report/pay/201910172139.shtml> (archived at <https://perma.cc/44UC-K7HH>).

²⁴ Fan Yuan [范媛] and Li Jingjing [李晶晶], “Government Guidance Funds Need to be Cleaned Up” [政府引导基金需要正本清源], China Economic Times [中国经济时报], December 2, 2016, http://lib.cet.com.cn/paper/szb_con/480397.html (archived at <https://perma.cc/82RN-WAWQ>).

investment (FDI) in 2018.²⁵ Foreign investors buy and sell shares in China’s publicly traded tech giants on exchanges in New York, Hong Kong, Shanghai, and Shenzhen, and invest in privately held technology companies through venture capital and private equity transactions.

Foreign tech companies also participate directly in China’s technology marketplace. They launch joint ventures and R&D labs, take part in Chinese industry alliances, buy stakes in promising Chinese startups, and invest millions or even billions of dollars in their Chinese operations.²⁶ According to CSET analysis, the last five years saw well over 700 corporate venture capital transactions involving Chinese startups and foreign investors, with investors in the United States, East Asia, Great Britain, and the European Union accounting for most of the deals. (See Figure 1 at the end of this document.) For example, Intel’s venture arm announced investments in two Chinese semiconductor firms just last spring.²⁷

In context, however, these activities seem somewhat less significant. \$11 billion in IT-related FDI in 2018 is nothing to scoff at, but firms in one subset of China’s IT industry, the artificial intelligence sector, raised over \$12 billion in disclosed venture capital and private equity funding alone that same year.²⁸ China- and Hong Kong-based companies made over five thousand corporate venture capital investments in China since 2016, far outpacing their peers from other countries.²⁹ On the public markets, the “BAT” companies and U.S.-listed firms do have significant foreign ownership. However, our informal review suggests that foreign shareholders hold a small minority of shares in key mainland-listed firms active in AI hardware, facial recognition, and other applications critical to the state’s technological strategy. (See Figure 2 at the end of this document.) And many important companies, such as Huawei and SenseTime, are not publicly traded at all.

There is also some evidence that American investors’ role in particular is diminishing over time. The Rhodium Group reports that U.S. foreign direct investment in China’s IT sector has declined steadily over the past several years, amidst generally flat or falling overall U.S.-

²⁵ China Statistical Yearbook 2019, Table 11-16, available at <http://www.stats.gov.cn/tjsj/ndsj/2019/indexeh.htm>. Official FDI statistics are prone to error, but this at least gives a sense of the magnitude of FDI flows. China’s leading sources of FDI include Singapore, Taiwan, South Korea, Japan, the United States, and Great Britain. See PRC Ministry of Commerce, “News Release of National Assimilation of FDI From January to October 2018” (November 22, 2018), <http://english.mofcom.gov.cn/article/statistic/foreigninvestment/201812/20181202815485.shtml>.

²⁶ See, e.g., Thilo Hanemann et al., *Two-Way Street – US-China Investment Trends – 2020 Update* (Rhodium Group, May 11, 2020), <https://rhg.com/research/two-way-street-us-china-investment-trends-2020-update/>; Roxanne Heston and Remco Zwetsloot, *Mapping U.S. Multinationals’ Global AI R&D Activity* (Center for Security and Emerging Technology, December 2020), <https://cset.georgetown.edu/research/mapping-u-s-multinationals-global-ai-rd-activity/>; Ngor Luong et al., *China’s Artificial Intelligence Industry Alliance: Understanding China’s AI Strategy Through Industry Alliances* (Center for Security and Emerging Technology, forthcoming 2021).

²⁷ “Intel Capital invests in Chinese chip companies amid tech tensions,” *Reuters*, May 13, 2020, <https://www.reuters.com/article/us-intel-investments-china/intel-capital-invests-in-chinese-chip-companies-amid-tech-tensions-idUSKBN22POGK>.

²⁸ Zachary Arnold, Ilya Rahkovsky, and Tina Huang, *Tracking AI Investment: Initial Findings from the Private Markets* (Center for Security and Emerging Technology, September 2020), 20, <https://cset.georgetown.edu/wp-content/uploads/CSET-Tracking-AI-Investment.pdf>.

²⁹ According to CSET’s analysis of the Crunchbase dataset; see Figure 1 for methodology.

China FDI flows.³⁰ U.S.-China venture capital investment has also fallen,³¹ and Crunchbase data indicate a similar decline in U.S.-investor corporate venture capital transactions.³²

These trends have many causes. Geopolitical developments are important, and in individual cases may be enough on their own to unravel cross-border financial relationships. In the aggregate, though, other factors often have a greater effect on foreign investment in China's tech industries. These include:

- Shifting dynamics within specific markets and investment channels. For example, both domestic and foreign VC investment in China contracted sharply in the past few years amidst overvaluation concerns.³³
- Broader macroeconomic trends in China and in investor nations.
- The growth and maturation of China's domestic capital markets.
- Domestic controls on inbound investment. For example, the Chinese government strictly limited foreign M&A activity within China until recently.³⁴
- State-subsidized loans and equity investment displacing foreign capital.
- The COVID-19 pandemic and resulting disruptions in the global financial markets.

Whatever the causes, the fact remains that foreign money plays a secondary role in today's Chinese technology sector.

However, capital is not the only resource Chinese firms draw from abroad. Foreign talent and expertise have also played a major part in China's technological development. The flow of these resources across borders - often in tandem with financial investment - is harder to track than dollars, but in this domain, too, there are some indications that China is growing less reliant on foreign inputs. The artificial intelligence sector is a case in point: Chinese universities have developed well-regarded AI programs, Chinese firms employ world-class AI researchers and engineers active across a range of applications, and in some AI subdomains, such as facial recognition, Chinese firms are innovating at the cutting edge or close to it.

³⁰ According to data from the U.S. China Investment Hub (Rhodium Group and National Committee on U.S. China Relations, 2020), <https://www.us-china-investment.org/>.

³¹ Adam Lysenko et al., *Disruption: US-China Venture Capital in a New Era of Strategic Competition* (Rhodium Group, January 13, 2020), <https://rhg.com/research/disruption-us-china-venture-capital-in-a-new-era-of-strategic-distrust/>.

³² 2020 saw 43 corporate venture capital transactions with U.S. investors and Chinese targets, down from 48 in 2019 and 75 in 2018. See text accompanying Figure 1 for methodology.

³³ See, e.g., "Investors Escape Artificial Intelligence" [投资人逃离人工智能], *36kr*, published September 26, 2019, <https://36kr.com/p/5250586>; Rita Liao, "China Startup Deals Shrink as Fundraising for Investors Plummet," *TechCrunch*, July 16, 2019, <https://techcrunch.com/2019/07/16/vc-pe-funding-slows-in-china/>; "China's Venture Capital Boom May Be Turning into a Bust," *The Straits Times*, July 9, 2019, <https://www.straitstimes.com/business/banking/chinas-venture-capital-boom-may-be-turning-into-a-bust>.

³⁴ See Linklaters, "A new era of liberalised inbound investment," <https://www.linklaters.com/en-us/insights/thought-leadership/china-report/china-inbound-investment-a-new-era-of-liberalised-inbound-deal-flow>.

AI may not be entirely representative, but we see similar signs in sectors from genomics to quantum science.³⁵ Not every sector fits the mold, though. For instance, Chinese semiconductor firms are still aggressively recruiting seasoned engineers and managers from Taiwan and elsewhere.³⁶ In semiconductor manufacturing and other industries that rely heavily on the implicit “know-how” and experience of human workers, Chinese firms will probably continue to rely on cross-border flows of expertise for some time - more than they depend on foreign capital, in any event. Even in more competitive sectors, such as artificial intelligence, China still benefits tremendously from talented, Chinese-born “sea turtles” returning from education and work in the United States.³⁷ Investment restrictions and other policies that address these flows, rather than focusing solely or primarily on financial capital, may be more likely to have an impact. I will revisit this point at the end of my testimony.

U.S. restrictions on investment in mainland-listed companies are unlikely to meaningfully affect the state of play

A 2020 executive order, relying on authority in Section 1237 of the FY1999 National Defense Authorization Act (PL 105-261), restricts U.S. investment in “Communist Chinese military companies” as designated by the Department of Defense. Some of the companies designated thus far, such as surveillance giant Hikvision and state-owned defense contractor Norinco, are traded on exchanges in Mainland China.³⁸

In my judgment, restricting U.S. investment in mainland-listed technology companies will have little impact on China’s technological development. Only a small subset of China’s tech companies are currently traded on the mainland.³⁹ Startups, by definition, are not publicly traded at all. The BAT companies are traded in New York or Hong Kong. And as noted above, many of the largest and most strategically relevant Chinese tech firms remain privately held.

³⁵ See, e.g., Philip Ball, “Physicists in China challenge Google’s ‘quantum advantage,’” *Nature*, December 3, 2020, <https://www.nature.com/articles/d41586-020-03434-7>; Jon Cohen and Nirja Desai, “With its CRISPR revolution, China becomes a world leader in genome editing,” *Science*, August 2, 2019, <https://www.sciencemag.org/news/2019/08/its-crispr-revolution-china-becomes-world-leader-genome-editing>.

³⁶ See Kensaku Ihara, “Taiwan loses 3,000 chip engineers to ‘Made in China 2025,’” *Nikkei Asia*, December 3, 2019, <https://asia.nikkei.com/Business/China-tech/Taiwan-loses-3-000-chip-engineers-to-Made-in-China-2025>; Jingyi Ge, “South Korea Fights to Guard Its Trade Secrets From China,” *Voice of America*, March 3, 2021, <https://www.voanews.com/east-asia-pacific/south-korea-fights-guard-its-trade-secrets-china>.

³⁷ See generally He Huifeng, “China’s overseas graduates return in record numbers into already crowded domestic job market,” *South China Morning Post*, September 21, 2020, <https://www.scmp.com/economy/china-economy/article/3102384/chinas-overseas-graduates-return-record-numbers-already>.

³⁸ See generally “Chinese Military Companies Sanctions,” Office of Foreign Assets Control, <https://home.treasury.gov/policy-issues/financial-sanctions/sanctions-programs-and-country-information/chinese-military-companies-sanctions>

³⁹ This may change in the coming years, as U.S.-China tensions continue and China pressures its tech companies to list at home, but it’s unclear how fast and how complete such a shift would be. Chinese firms still have strong incentives to list in the United States. See Quentin Webb and Jing Yang, “Chinese Companies Head Home to Raise Money, as Beijing’s Relations With U.S. Fray,” *Wall Street Journal*, Sept. 27, 2020, <https://www.wsj.com/articles/chinese-companies-head-home-to-raise-money-as-beijings-relations-with-u-s-fray-11601199002>; Jing Yang, “‘The Gold Standard’: Why Chinese Startups Still Flock to the U.S. for IPOs,” *Wall Street Journal*, August 13, 2020, <https://www.wsj.com/articles/the-gold-standard-why-chinese-startups-still-flock-to-the-u-s-for-ipo-11597313278>.

Restricting U.S. investment in the mainland exchanges would not directly affect any of these companies.

On the other hand, high-tech companies traded in Shenzhen or Shanghai, such as speech recognition powerhouse iFlyTek, AI chip designer Cambricon, and cybersecurity specialist Qihoo 360, would be exposed to these restrictions. Shenzhen-listed Hikvision, for example, has been dropped from indices and exchange-traded funds since its designation by the Department of Defense.⁴⁰ But mainland shareholders own the vast majority of outstanding shares in these companies; U.S. investors hold small stakes. (See Figure 2 at the end of this document.) Forcing them to liquidate these stakes would not necessarily harm the companies. More likely, investors from China or other countries would quickly fill the (small) gap.

Finally, recall that the Chinese government has shown itself willing to invest copiously in firms it considers strategic. In the unlikely event that U.S. investment restrictions posed a serious, lasting threat to any such firm, the Chinese government would probably just compensate with capital of its own.

In short, mainland-listed tech firms companies to face little risk from U.S. investment restrictions. For American policymakers hoping to influence China's technological development, two responses are possible. First, broaden these restrictions to cover many more companies - Chinese firms listed elsewhere, for example, or all privately held tech companies with potential ties to China's military. Second, develop well-informed, narrowly tailored investment restrictions targeting true bad actors while focusing on levers of influence outside the investment domain. For three reasons, I believe this second approach is sounder.

First, expanded U.S. investment restrictions would be hard to target properly. The ties between Chinese companies and the government are often difficult to trace, and as the scope of restrictions expands, drawing a line that can reliably separate actors and activities of concern becomes harder. Virtually any Chinese high-tech firm could be said to have some relationship with the state, if only by virtue of laws that give all Chinese companies a general obligation to cooperate with the government.⁴¹ And most of the emerging technologies central to today's geopolitics, such as artificial intelligence, are dual-use or general-purpose technologies that can theoretically be used for both peaceful and military uses. This complicates the task of identifying companies worth targeting with investment restrictions, and makes it more likely that broad restrictions will prevent legitimate transactions that pose relatively little risk to U.S. national security.

Second, targeting too many Chinese companies or sectors - or simply giving up, and deeming all Chinese companies presumptively off limits - could cause serious collateral damage. American investors have good reasons to invest in Chinese tech companies. They offer strong

⁴⁰ See Max Chen, "China ETFs Could Look Different as the U.S. Blacklists Military Companies," *ETF Trends*, December 8, 2020, <https://www.etftrends.com/smart-beta-channel/china-etfs-could-look-different-as-u-s-blacklists-military-companies/>.

⁴¹ See Ashley Feng, "We Can't Tell if Chinese Firms Work for the Party," *Foreign Policy*, February 7, 2019, <https://foreignpolicy.com/2019/02/07/we-cant-tell-if-chinese-firms-work-for-the-party/>.

returns and an important opportunity to diversify portfolios; private-market investment in Chinese companies can also help U.S. corporations unlock lucrative Chinese markets and access Chinese talented workers. Given these benefits, it's unsurprising that despite severe geopolitical headwinds, American companies are still taking stakes in Chinese startups, American financial institutions are maintaining their positions in China's publicly traded tech firms as the law permits, and American investment managers continue to recommend investing in China.⁴² Any restrictions strong enough to significantly disrupt U.S.-China investment flows would deny American investors the significant benefits of exposure to the Chinese market, with unpredictable and possibly severe economic harm ensuing.

Third, expanded restrictions might not meaningfully limit the targeted firms' and sectors' access to capital. There is plenty of money in the world, and much of it is beyond America's reach; investors around the world, and in China itself, are eager to tap the Chinese tech market. Already, there is evidence that firms in other East Asian countries and in Europe and are not necessarily receptive to American calls to "decouple" from China.⁴³ At a minimum, similar dynamics would probably blunt the effect of expanded U.S. investment restrictions.

To be clear, there are good reasons for American policymakers to consider restricting investments in China's technology sector. Tech firms listed on the mainland exchanges are implicated in grave human rights abuses, and intentionally or not, their technology enables the Chinese Communist Party and its strategy for continued authoritarian rule.⁴⁴ It is reasonable to believe that American capital should not be used for these ends. We should restrict U.S. investment, consistently and transparently, in companies that violate human rights, but we can't assume these policies will necessarily slow China's technological development.

⁴² See, e.g., Michael Hood et al., *Understanding the opportunity in Chinese equities* (J.P. Morgan Asset Management, June 18, 2020), <https://am.jpmorgan.com/ca/en/asset-management/institutional/insights/portfolio-insights/equity/understanding-the-opportunity-in-chinese-equities/> (China "offers a range of opportunities, along with certain risks. Our view of these opportunities is built on the belief that China will continue to deliver superior nominal economic growth relative to other markets over our 10- to 15-year forecast period To be sure, it may seem an inopportune time to even think about, let alone increase, your allocation to China's equity markets, given the steady drip of negative U.S. news dampening sentiment, the Holding Foreign Companies Accountable Act, the Uyghur Human Rights Policy Act, the revocation of Hong Kong's special status and the re-escalation of U.S.-China trade tensions, to name but a few. . . . Yet the fact remains that China is in the early stages of a financial evolution that will likely offer patient investors a significant opportunity over the next 10 to 15 years. And it is important to remember that periods of uncertainty, like today, can offer opportunities for those willing to look through the news and focus on earnings per share (EPS) growth, which ultimately drives investment returns.").

⁴³ See, e.g., PRC Ministry of Commerce, "Paid-in investment up 6.2% in 2020, hitting record high," January 22, 2021, <http://english.mofcom.gov.cn/article/newsrelease/significantnews/202101/20210103033600.shtml>; Mitsuru Obe, "Decoupling denied: Japan Inc. lays its bets on China," *Nikkei Asia*, February 10, 2021, <https://asia.nikkei.com/Spotlight/The-Big-Story/Decoupling-denied-Japan-Inc.-lays-its-bets-on-China>.

⁴⁴ See, e.g., Will Knight, "MIT Cuts Ties With a Chinese AI Firm Amid Human Rights Concerns," *Wired*, April 21, 2020, <https://www.wired.com/story/mit-cuts-ties-chinese-ai-firm-human-rights/>; Ben Dooley, "Chinese Firms Cash In On Xinjiang's Growing Police State," *Agence France-Presse* (June 27, 2018), <https://www.afp.com/en/chinese-firms-cash-xinjiangs-growing-police-state>.

Any U.S. restrictions on investment in China should be multilateral, better informed, and part of a broader strategy to maintain the technological advantage of the United States and its democratic allies

If investment restrictions are imposed in some form, U.S. policymakers do have some ways to make them more likely to have an impact. But in parallel, and probably more importantly, policymakers should exploit America's larger and more durable advantages over China in other domains.

Any investment restrictions should be multilateral

As noted above, U.S. investors are part of a global marketplace. If new laws force Americans to withdraw from profitable investments on the mainland, investors elsewhere will be happy to take their place. For this reason, unilateral U.S. investment restrictions are much less likely to alter China's technological trajectory.

Even multilateral restrictions may not have the desired effect, though. For example, public data suggest the mainland-listed tech companies listed in Figure 2 have few foreign investors at all, so foreign-imposed restrictions (whether unilateral or multilateral) may not directly affect them. Multilateral restrictions may also need to be narrowed in order to achieve consensus with foreign partners, but a narrower set of more effective restrictions would seem more valuable than a broader set of relatively toothless ones.

Properly targeted investment restrictions may be possible, but require better information

The FY2021 National Defense Authorization Act (PL 116-283) broadened the range of firms potentially subject to Section 1237 investment restrictions, including by expanding the definition of Chinese "military companies" to include "contributors" to China's military-civil fusion strategy.⁴⁵ Within this broad remit, if U.S. policymakers could target the channels and companies of greatest concern, investment restrictions could conceivably help contain the Chinese government's more troubling technological ambitions and avoid collateral damage. But this sort of careful targeting requires a richer understanding of China's technological ecosystem than we currently have.

Our knowledge is especially limited with respect to private-market investments, such as venture capital, which are not subject to securities disclosure laws. From a technology transfer perspective, transactions involving Chinese *investors* and U.S. *targets* are usually assumed to be riskier. That may be true in general, but Chinese startups - and, indirectly, the domestic industries in which they participate - also benefit from U.S. investment, and not just in the form of capital. In particular, private-market investors may also provide technical and

⁴⁵ See § 1260H(c) of the FY2021 National Defense Authorization Act, available at <https://www.congress.gov/bill/116th-congress/house-bill/6395/text>.

financial expertise, connections to potential customers and collaborators, market intelligence, and so on.⁴⁶

To reliably identify when these transfers pose unacceptable risks and should be restricted, policymakers need to know, at a minimum:

- Which U.S.-to-China transactions are taking place or being considered
- Whether the U.S. investors have unique expertise or other resources
- Whether these resources are likely to be shared with the Chinese targets as a result of the transaction
- Whether the targets have other ways to access the same resources
- Whether the targets' activities are directly relevant to national security or to technological areas of particular interest to the Chinese government
- The nature, extent, and consistency of the targets' relationship with the Chinese authorities
- What benefit the U.S. investors stand to gain from the transactions

To my and my colleagues' knowledge, there is no office or agency, inside or outside government, that is currently able to provide this comprehensive view, whether in specific sectors or more broadly. Without it, restrictions on China-bound investments could inadvertently block innocuous deals and allow dangerous ones through. The federal government should invest in the analytic capacity that is needed to gain this comprehensive view - including, critically, stronger open-source intelligence capabilities related to China's science and technology ecosystem.⁴⁷ Doing so would both improve potential restrictions on U.S. investment in China and bolster other efforts to meet China's technological challenge in the decades to come.

Focus on American advantages in other domains

Capital, particularly American capital, is not currently a limiting factor in China's technology industry. I expect restrictions on US-China capital flows will be useful primarily to the extent they indirectly capture other, more critical resources flowing alongside the money, such as talent and expertise. Focusing more directly on these critical resources could yield better results.

For instance, America's ability to attract the world's top scientists, engineers, and entrepreneurs is a unique asset - one that fueled our economic, scientific, and military

⁴⁶ See, e.g., Samir Kaji et al., *Inside the Minds of Corporate Venture Capitalists* (CBInsights, December 10, 2015), <https://www.cbinsights.com/research/inside-corporate-vc-minds/>.

⁴⁷ See William Hannas and Huey-Meei Chang, *China's STI Operations: Monitoring Foreign Science and Technology Through Open Sources* (Center for Security and Emerging Technology, January 2021), <https://cset.georgetown.edu/research/chinas-sti-operations/>.

supremacy throughout the twentieth century. Today, Xi Jinping has described talent as “the first resource” in his country’s quest for technological independence, and China is aggressively working to attract talented foreigners and Chinese expatriates, with mixed results.⁴⁸ In my judgment, consolidating the U.S. talent recruitment advantage over China - by investing in research and development, strengthening our higher education system, and fixing outdated and restrictive immigration laws - would do more for America’s national security than restricting outbound investment.

Talent is the most obvious place to start, but the United States has other assets that are worth protecting. These include robust alliances with technologically sophisticated peer nations; dominant positions in certain “chokepoint” technologies fundamental to a wide range of capabilities, especially when allies’ capabilities are taken into account; a diminished but enduring “soft power” advantage; and a market-driven economic system in which innovators and entrepreneurs can thrive.⁴⁹ If America wants to remain a contender in the global competition for technological leadership, it must protect and build on these strengths.

⁴⁸ Remco Zwetsloot and Dahlia Peterson, “The US-China Tech Wars: China’s Immigration Disadvantage,” *The Diplomat*, December 31, 2019, <https://thediplomat.com/2019/12/the-us-china-tech-wars-chinas-immigration-disadvantage/>.

⁴⁹ See generally Andrew Imbrie et al., *Agile Alliances: How the United States and Its Allies Can Deliver a Democratic Way of AI* (Center for Security and Emerging Technology, February 2020), <https://cset.georgetown.edu/research/agile-alliances/>; Saif M. Khan, *The Semiconductor Supply Chain: Assessing National Competitiveness* (Center for Security and Emerging Technology, January 2021), <https://cset.georgetown.edu/research/the-semiconductor-supply-chain/>.

Figure 1: Corporate venture capital investments involving foreign investors and Chinese targets, 2016-2020

Investor country	Number of investments
United States	256
Singapore	112
Taiwan	79
Japan	66
Great Britain	62
South Korea	40
Germany	39
France	18
Portugal	18
Switzerland	15
Netherlands	10
Other/unknown	65
Total	780

Source: CSET analysis of Crunchbase data extracted March 2021. Corporate venture investors are defined as investors that either a) are publicly traded, b) have more than five thousand employees or c) are subsidiaries of such organizations. Hong Kong-based investors are counted as domestic. For further details, see Rebecca Kagan et al., *Corporate Investors in Top U.S. AI Startups* (Center for Security and Emerging Technology, February 2021), <https://cset.georgetown.edu/research/corporate-investors-in-top-u-s-ai-startups/>.

Figure 2: Largest foreign shareholders in high-profile, mainland-traded Chinese technology firms

Company	Application area	Exchange	Largest non-Chinese shareholder	Percentage of outstanding shares owned
iFlyTek	Speech recognition	Shenzhen	The Vanguard Group	0.22%
Qihoo 360	Cybersecurity	Shanghai	BlackRock Institutional Trust Company	0.15%
Hikvision	Surveillance	Shenzhen	Capital Group Global Investors	0.5%
Sugon	Supercomputing	Shanghai	Dimensional Fund Advisors, L.P.	0.15%
SMIC	Semiconductors	Shanghai, Hong Kong	The Vanguard Group	0.84%

Source: Refinitiv data as of March 9, 2021. Pursuant to Executive Order 13959, U.S. investors are not currently allowed to purchase shares in Hikvision, Sugon, and SMIC, but have until late 2021 to divest from existing positions.